February 4, 1954

Continuation of Transposition of Ds; Locations of Ds in short arm of chromosome 9. The missing regions; why. The states of Ds.

I. Begin again, Transposition Ds 4755D. page 3 of February 1 discussion.

II. A second illustration - Ds 4710.

1. Origin: in cross of

$$c\ sh\ Bz\ wx\ ds\ ac \text{ female x } \frac{C\ Sh\ Bz\ Wx\ Ds}{C\ sh\ Bz\ wx\ ds}\ \frac{Ac}{ac} \text{ male}$$

Appearance of kernels on ear -- Table: 1 Table (1) in Ds 4710 account.

2. Variegation exhibited by odd kernel: Breaks between Sh and Wx:

a). C Sh Wx with c sh Wx areas. wx subareas in c/Wx sectors. Places Ds to left of Wx.

b). No twin deep C - c areas. Places Ds to right of C

3. Plant grown from kernel in greenhouse. Presumed consitution:

$$\frac{C\ Sh\ Ds\ Wx}{c\ sh\ ds\ wx}\ \frac{Ac}{ac}$$

Position with regard to Bz required determination.

4. Greenhouse plant crossed to:

(1) c sh Bz wx ds ac plant: Showed Ds between Sh and Wx.

(2) C sh bz wx ds ac plant: Showed Ds to right of Bz: Between Bz and Wx.

5. Tables will be given from crosses made in field the following summer.

a). Selected C Sh Wx variegated kernels from cross (1)

b). Plants grown from them in following summer.

c). Crossed to female plants: c sh Bz wx ds ac. Kernels on ear:

Table on board. (2). Table 5 in account of Ds 4710 [illegible]

A

d). Crossed to C sh bz wx ds ac female plants: Types of kernels on ear: Table on board.

[Difficulty in classifying all of the variegated kernels: the spread of Bz substance into bz areas. Only kernels that could be classified with great certainty placed in variegated classes.]

B

e). Variegated kernels selected from cross of greenhouse plant to C sh bz wx ds ac plant:

Presumed constitution: $\frac{\text{C Sh Bz Ds Wx}}{\text{C sh bz ds wx}}$ $\frac{\text{Ac}}{\text{ac}}$

Crossed to C sh bz wx ds ac female plants. ~~Table on board~~:

Crossed to c sh Bz wx ds ac female plants.

Not crossed to c sh bz wx ds ac female plants as this stock not available at time tests were made.

6. Comparisons of variegated kernels from all of the crosses:
Table on board: ③. Table 9 in accounting Ds 4710

Selection of one of the two crossover classes in each case. Therefore, the ratios give the cross-over percentages:

$$\begin{array}{ccc} & 1 & 2 \\ \text{Sh} & \text{Ds} & \text{Wx} \\ \hline \text{sh} & \text{ds} & \text{wx.} \end{array}$$

The	~~C~~ Sh ~~Bz~~ ~~Ds~~ Wx Ac kernels:	1138	
"	sh Ds Wx kernels (Ac):	135	9.13%
2	Sh Ds wx; Ac kernels :	205	13.87%
			23% the normal amount between Sh and Wx.

The position of Ds4710:

$$\begin{array}{ccc} \text{Sh} & \text{Ds} & \text{Wx} \\ \hline & 1 \quad : \quad 1.52 & \end{array}$$

III. The position where Ds has entered and been studied: The selection Non-random.

general

1. I Sh Bz Wx

c.o. to I : 8% 5 0

" : 4%

several positions only.

2. Positions between I and Sh:

```
I                                Sh
_________________________________________
        ↑                         ↑

     3 cases                   2 cases
1/5 crossover distance         Just to left of Sh
between I and Sh
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3. Reasons why Ds not seen in other positions: Produce either lethal condition in heterozygote -- dominant lethal, or very much reduced viability.

   a). Evidence from observed transpositions between Bz and Wx -- many give defective kernels. Some give defective embryos; some give normal kernels but these do not germinate.

   b). Kernels from about half of the cases of transposition of Ds to new positions did not give plants even when they appeared to be normal.

   c). Study of effects of Ds when located between I and Sh -- produces dominant lethals or low viabilities in heterozygote -- will be discussed later.

4. What about cases of insertion of Ds at known loci? Produce mutable genes. This must be postponed until another aspect of Ds discussed.

IV. What happens to Ds at the standard location?when transpositions occur?

1. Cases of no Ds at standard location: I Sh Bz Wx Ds to Ds I Sh Bz Wx No Ds at standard location.

2. Cases of Ds at standard location: Two types:

   Ds^1 I Sh Bz Wx Ds^2 - both Ds's give frequent breaks.

   Ds^1 I Sh Bz Wx Ds^2 - Ds^1 gives many breaks but Ds^2 behaves quite differently.

3. The nature of the difference in behavior of the two types of Ds will be discussed. Important for our understanding of mutable loci and their action.

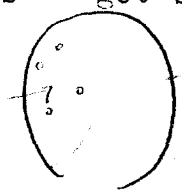
V. The changed states of Ds.

1. The first case of recognition of altered Ds action. The cross:

$$\text{C sh bz wx ds ac female} \times \frac{\text{I Sh Bz wx Ds}}{\text{C sh bz wx ds}} \quad \frac{\text{Ac}}{\text{ac}} \text{ male}$$

2. The pattern of variegation exhibited by majority of kernels: Like that of photographs when 1 Ac present.

3. In all tests -- get sectors on some of the kernels:



4. Occasionally, a whole kernel has this type of pattern. What has changed? Is it Ds ? Is it Ac?

5. The tests to discover this:

a). Kernels taken off ear; plants grown from it. Crosses to C sh bz wx ds ac females. The same pattern appears in variegated kernels as that from which plant arose.

Crosses to c sh Bz wx ds ac; Crossover classes with C and Ds: the pattern in the C - c kernels:

Same as that from which plant arose.

Crossed to I Sh Bz Wx Ds no Ac. The constitution of the kernels:

I Sh Bz Wx Ds / I Sh Bz wx "Ds" 1 Ac. Considerable amount of variegation -- wx areas.

I Sh Bz Wx Ds / C sh bz wx ~~ds~~ 1 Ac -- many C sh bz wx areas.

b). Kernels from the I Sh Bz Wx Ds / I Sh Bz wx "Ds" with large wx areas removed. Plants grown from them, crossed to C sh bz wx ds ac female plants.

The types of kernels on the resulting ears: Table:

I Wx, non-variegated	425
I wx, non-variegated	412
I Wx var. usual pattern	361
I Wx var. new pattern	34*
I wx var. usual pattern	10
I wx var. new pattern	364

c). Conclusions: It is not the Ac factor that is responsible for the altered pattern. Ds in the Wx carrying chromosome behaved normally with regard to pattern. Like theAc in the plant that gave rise to the original aberrant kernel.

(2). It is the Ds in the I Sh Bz wx chromosome that is altered.

(3). The 10 kernels in the I wx class showing the regular pattern probably arose from crossing-over:

$$\frac{I \qquad Wx\ Ds}{I \qquad wx\ Ds^{r.p.}}$$

(4). The 34 kernels with the new pattern proabably arose from several causes:

(a). From crossing-over

(b). New changed in the Ds in the I Sh Bz Wx Ds chromosome.

(c). Possible changes in action of Ac.

V. ~~Exam~~ Tests of the stability of the new pattern of variegation produced by the altered Ds.

1. The original change from regular pattern to new pattern comes in one step: The few kernels with these patterns in crosses and the appearance of an occasional sector suggest this.

2. Can the Ds change back to the original type of variegation pattern?

3. The test methods: I Sh Bz Wx or wx Ds-altered pattern carrying plants crossed to C sh bz wx ds ac plants.

(a). Kernels on ears examined for any showing a higher frequency of breaks. Few found. These removed from ear, plants grown from the.

(b). These plants, in turn, crossed to C sh bz wx ds ac plants. Majority of variegated kernels on ear now like that which gave rise to plant. A few kernels with slightly more variegation. These, in turn, selected, plants grown from them, and crosses made to C sh bz wx ds ac plants.

(c). Again, majority of/variegated kernels on ear show the pattern given by the kernel from which the plant arose.

(d). It required about 3 generations of careful selection to get a Ds that behaved like the original Ds that produced the f-1. pattern.

4. These differences in the behavior of Ds -- altered states of Ds.

VI. The meaning of these states is very important and will be much clarified when the mutable genes are considered. Before doing this, will discuss, brifely at beginning of next period, the method of transposition of Ds.

① Df 4710 C Sh Bz Df Wx

Table 1. Origin:

♀ c sh Bz wx, ds ae × ♂ $\frac{C\ Sh\ Bz\ Wx\ Df}{c\ sh\ y\ wx\ ae}$ $\frac{Ae}{ae}$

Non-crossover classes: C Sh Wx – non-var. = 204
var = 183

C sh wx – non-var = 222
var. = 2

Crossovers sh to Wx

C sh wx – non-var = 89
var = 0

C sh Wx – non-var = 78
var = 64.

1 kernel = C Sh Wx with c sh Wx areas. The latter have wx areas within them. No deep C-c twin sectors

Suggests: Df between Sh and Wx.

Deficiency in sh + wx classes not to be considered here – another problem.

(2) (2) on board B4710

Table 5. c sh bz wx ds ae gl × $\frac{C' Sh\ Bz [Ds] Wx}{c\ sh\ Bz\ ds\ wx}$ $\frac{Ac}{ac}$ ♂♂

C.O. $\frac{C'\ Sh\ [Ds]\ Wx}{c\ sh\ ds\ wx}$ (1, 2)

Appearance of kernels.

Non-crossovers.

C Sh Wx - non-var. 568, var. = 502 } 1:1

c sh wx = 982

Cross-over Reg 1

C sh wx - non-var = 43, var = 0

c Sh Wx - non-var = 23, var. = 25 } 1:1

Cross-overs Reg. 2

C Sh wx - non-var. = 165, var. = 73

c sh Wx - non-var = 214, var = 47

Regions 1+2

C sh Wx - non-var. = 5, var. = 1

c Sh wx = 3

③ ③ on board Ds 4710

Table 9.

$$\frac{Sh \overset{1}{\ } Ds \overset{2}{\ } Wx}{sh \quad ds \quad wx}$$

The variegated kernels.

Table	Non crossovers in ShWx class. (ShWx → wx var.)	Cross-overs, Sh to Ds (shWx → wx)	Cross-overs. Ds to Wx (CSh wx var. kernels)	Total Number of kernels
5-6	601	58	88	746
6	371	42	62	475
7	139	25	42	206
8	27	10	13	50
Totals	1138	135	205	1477

9.13% 13.87%

23% c.o. sh to Wx.

Sh Ds Wx

1 : 1.52

Transposed Do 4710 = C Sh Bz Ds Wx.

4675-B-2

1. Origin = Table 1. Increase of C sh Bz wy ... x $\frac{\text{C Sh Bz Wx Do}}{\text{C sh Y wy os}}$ $\frac{Ac}{ac}$.

non-c.o

C Sh Wx - non-var = 204
C Sh Wx - var = 183. C Sh Wx with c sh wy areas.

C sh wy - non-var = 222
C sh wy - var = 2

c.o. Sh to Wx

C Sh wy - non-var = 89
C Sh wy - var = 0

Deficiency of sh wy class not to concern us here.

C sh Wx - non-var = 78
C sh Wx - var = 64

1 odd kernel = C Sh Wx with cases that were Wx in which wy areas appeared.

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2. Table 2 = C sh Y wy ... x $\frac{\text{C Sh Bz Wx Ds}}{\text{C sh Y wy os}}$ $\frac{Ac}{ac}$. Same as cross above = 4675 B-2

(donut wp)

non-c.o. C Sh Bz Wx - non-var = 63
C Sh Bz Wx - var = 57 (C sh Y wy areas)

C sh Y wy = 109

reg. 1 C sh Bz Wx - non-var = 0
C sh Bz Wx - var = 3

C Sh Y wy os = 5

(2

on board

C.O. Reg. 2

C Sh Bz wx — non-var = 38 ; var = 0

C sh bz Wt — non-var = 31 ; var = 15

probably
(some var. not detected, different unless whole kernel examined). Later, rapid detection method found. Light transmission.)

Aberrant kernel = plant 4710. greenhouse. $\frac{C' Sh\ Bz\ Ds\ Wt}{c\ sh\ Bz\ ds\ wx}$ Ac / ac

T

1. To c sh Bz wx ds ac ♀

			Down ure. Greenhouse Table 3	Tables field following summer	Table 5b Totals Positive
non-co.	C Sh Bz Wt	non-var	98	568	666
		var	69	502	571
	c sh wx		182	982	1164
Reg1	C sh wx	non-var	9	43	52
		var	0	0	0
	c Sh Wt	non-var	9	23	32
		var	5	25	30
Reg2	C Sh wx	non-var	25	165	190
		var	14	73	87
	C sh Wt	non-var	30	214	244
		var	10	47	57
Reg1+2	C sh Wt	non-var	1	5	6
		var	0	1	1
	c Sh wx		0	3	3

1:1 (568/502); 1:1 (23/25)

(3

Cshy ex or f_+^o + $\frac{C\,Sh\,Bz\,Ds\,Wx}{C\,sh\,Bz\,ds\,ex}$ $\frac{Ac}{a}$ onboard

4710 - gradient + field → C sh Bz ds ex

5163 -

Table 6

	Kernel type		
non-cursor	C Sh Bz Wx	non-var =	549
		var =	371
	C sh Bz ex	non-var =	968
		var =	0
C.O. Sh Bz Wx	C Sh ex	non-var =	170
		var =	62
	C sh Wx	non-var	197
		var	42

Difficulty in using bronze c.o.

.. stock not available at time.

Substitution of cshy ex f_+^o later

(4

Filed on bee

C sh y wx asa × C $Sh^1 Bz^2$ D Wx / C sh y as wx — Ae / or — Kernels (from greenhouse cross)

Table 7

Kernel Appearance.

non-crossovers	C Sh Bz Wx — non-var	=	174
	— var	=	139
	C sh y wx	=	325
Reg 1	C Sh y wx	=	10
	C sh Bz Wx — non-var	=	18
	— var	=	4
Reg. 2	C Sh Bz wx — non-var	=	131
	— var	=	42
	C sh y Wx — non-var	=	135
	— var	=	24
Reg 1 + 2	C sh y Wx	=	0
	C sh Bz wx	=	3 non-var

Crosses from field tests:

The variegated kernels only. (Those with Ac)

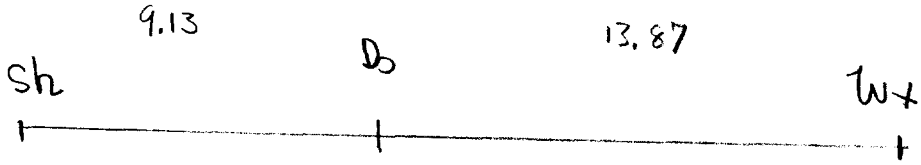
Table 9

$$\frac{Sh^{1}\ Ds^{2}\ Wx}{sh\ \ ds\ \ wx}$$

On board

Reference	non-crossovers, Sh to Wx	Sh to Ds	Ds to Wx	Number of kernels
Table 5-6	601	58	88	746
Table 6	371	42	62	475
Table 7	139	25	42	206
Table 8	27	10	13	50
Totals	1138	135	205	1477

% c.o.		9.13	13.87



Ratio : 1 : 1.52

Transposed Ds 4755 C

1. Origin. Col lg wx Ds ac ♀ × $\frac{\text{I Sh Bz Wx Ds}}{\text{I Sh Bz wx Ds}}$ Ac ac ♂ Table 1

Ear: I Wx non-var = 102
I wx, non-var = 112 } = 214

I Wx with C lg wx areas = 104
I wx " c lg wx " = 84 } = 186 → Breaks to right of Wx.

5 Odd Kernels: (high freq. gamete kernel)
2 I with wx areas; I with C lg wx areas; = Triploids.
Proved to be I Sh Bz Wx Ds / I Sh Bz wx Ds

1 I Sh Bz wx kernel with pattern of losses suggesting Ds to left of I. = Ds 4577C

Will discuss this case. 1 I Sh Bz Wx with breaks occurring between Bz and Wx = Ds 4577 D

1 I Sh Bz Wx with breaks to left of I. no germination

2. Plant from aberrant kernel = $\frac{\text{I Sh Bz wx}}{\text{C sh lg wx}}$ + Ac:

Crossed to C sh lg wx ds ac ♀. Kernel types:

Table 2

$\dfrac{I\ Sh\ Bz}{C\ sh\ y}$

I kernels

I Sh non-var = 440

= 816

I Sh with C Bz-C y var = 376

I sh bz non-var = 27

= 49

I sh y with C y areas = 22 (describe phenotype).

C sh y = 793

C Sh Bz, non-var = 55

C sh Bz, non-var = 15

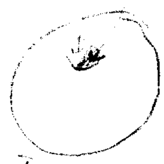
Test 2. Same ♂ to c sh Bz ds ♀. Table 3.

I Kernels = I Sh = 317 = non.c.o.

I sh = 17 = c.o.

Deep C, with c areas

c



C kernels = C Sh non-var = 16 = c.o.

C sh with areas of c. These associated with deep C area: including c areas. Appear: also ...

non-c.o.

C sh non-var = 299

$\frac{I\ Sh\ Bz\ wx}{C\ sh\ y\ wx}$ $\frac{Ac}{ac}$

Test 3. same ♂♂ have been crossed to C sh y Wx as ac ♀♀

the I Sh Bz Wx kernels showing var. selected. = $\frac{I\ Sh\ Bz\ wx}{C\ sh\ y\ Wx}$ $\frac{Ac}{ac}$
Plants grown from them.

used as ♂♂ to C sh y wx ac ac ♀♀

Table 4

4% 20% 18%

$\frac{Ds\ {}^{0}I\ {}^{1}Sh\ {}^{2}Bz\ {}^{3}wx}{ds\ C\ sh\ y\ Wx}$ = cross-over regions $\frac{Ac}{ac}$

I kernels.		C kernels.	
I Sh Bz wx (and Ds) kernels.	non-var = 574 var (break to left of I) = 448 = 1022	C sh y Wx	non-var = 1201 areas of wx = 69 = 1269
c.o. 1 I sh y Wx kernels.	non-var = 48 areas with C y sh Wx - small x in them = 42 = 90	C Sh Bz wx	non-var = 76 var. = 0
c.o. 2 I Sh y Wx	non-var = 34 var = 22 C y areas, no var of Bz.	C sh Bz wx	non-var = 43 var = 0
c.o. 3 I Sh Bz Wx	non-var = 163 var (break to left of I) = 137	C sh y wx	= 311
I sh Bz wx c.o. reg 2 + 3	non-var = 4 var = 3	C Sh Bz Wx	non-var = 7 var = 0

7
odds = 1 pec. I sh Bz Wx kernel.

c.o. 2+3 = 2 C sh Bz wx non-var

Total C kernels = 1708

c.o. Ds to I = 8.07%

" I to Sh = 5.6%

" Sh to Wx = 20.7%

Test 4 Same ♂♂ to c sh Bz wx ♀♀ : See Table 5.

c sh wx ♀ × $\frac{\text{Ds}^{\circ\;1.\;2} \text{ I Sh wx}}{\text{ds C sh Wx}}$ $\frac{Ac}{ac}$ ♂♂.

I kernels (= colorless).

I Sh wx = 1167
(var. for sh not recorded; too difficult to classify each case)

Reg 1
I sh Wx – non-var = 59 = 107
– var. for wx = 48

Reg 2
I Sh Wx – non-var = 219 = 411
– var. for wx = 192

Reg 1+2
I sh wx = can't tell var. = 17 *

Total I Kernels =

* Because of no color, probably most belong to I Sh wx var. class with early losses giving colorless sh in most of kernel.

C sh Wx non-var = 1287 = 1355
" var = 68 Break to left of C. c.o. a

C Sh wx – non-var = 96
– var = 0

C sh wx – non-var = 390
– var = 3 Break to left of C
c.o. a + 2

C Sh Wx – non-var = 4
– var. = 0

C kernels = 1848

c.o. a = 68 + 3 = 71 × 2 = 142 = 7.7%
(Ac) (ac)

C.o. Reg 1 = 96 + 4 = 100 = 5.4%

C.o. Reg 2 = 390 + 3 + 4 = 397 = 21.4%